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(71) Applicant: PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(71) Applicant *(for SE only)*: PHILIPS NORDEN AB [SE/SE]; Kottbygatan 5, Kista, S-164 85 Stockholm (SE).

(72) Inventors: KEES, Antonie, Hubert, Marie; Frontstraat 2, NL-5405 PB Uden (NL). KESSELS, Martinus, Joseph, Maria; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL). VAN LIEROP, Fransiscus, Henricus; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(74) Agent: DUSSELDORP, Jan, C.; Internationaal Octrooibureau B.V., P.O. Box 220, NL-5600 AE Eindhoven (NL).

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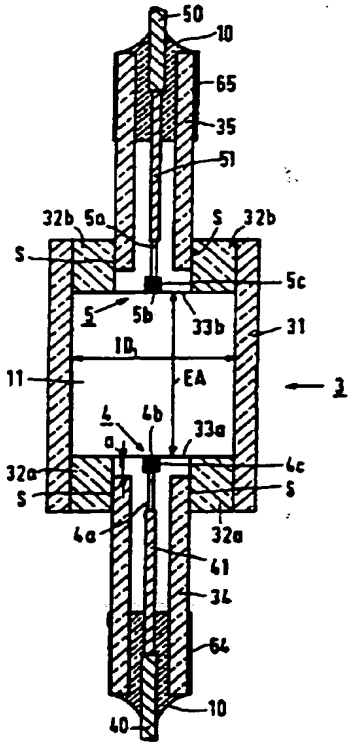
(54) Title: HIGH-PRESSURE DISCHARGE LAMP

(57) Abstract

The invention relates to a high-pressure discharge lamp provided with a discharge vessel (3) which encloses a discharge space (11), which has a ceramic wall, and which is sealed at one end by means of a projecting ceramic plug (34, 35) which encloses with clearance a current supply conductor (40, 41, 50, 51) to an electrode (4, 5) arranged in the discharge vessel and is connected to said conductor adjacent an end facing away from the discharge space in a gastight manner by means of a melting-ceramic connection (10). According to the invention, at least an end portion of the ceramic plug situated near the end facing away from the discharge space is impermeable to light.



High-pressure discharg lamp.

The invention relates to a high-pressure discharge lamp provided with a discharge vessel which encloses a discharge space, has a ceramic wall, and is sealed at one end by means of a projecting ceramic plug which encloses with clearance a current lead-through to an electrode arranged in the discharge vessel and is connected to said lead-through in a gastight manner by means of a melting-ceramic connection at an end facing away from the discharge space.

A lamp of the kind mentioned in the opening paragraph in the form of a high-pressure sodium lamp is known from GB 2 083 692/US 4 910 433, and in the form of a metal halide lamp from EP 0 587 238.

A ceramic wall or plug in the present description and claims is understood to be made of one of the following materials: monocrystalline metal oxide (for example, sapphire), densely sintered polycrystalline metal oxide (for example, Al_2O_3, YAG), and polycrystalline densely sintered metal nitride (for example, AlN).

The chosen construction is highly suitable for lamps of comparatively low power and correspondingly comparatively small dimensions, in particular having a comparatively small electrode interspacing. To prevent excessively high temperatures at the area of the melting-ceramic connection during lamp operation, the seal of the discharge vessel is constructed as a projecting plug, and the melting-ceramic connection is realised near an end of the projecting plug which faces away from the discharge space.

The melting-ceramic connection between the projecting plug and the current lead-through is achieved in a furnace in a firing process. For this purpose, the projecting plug and the current lead-through are heated together with a quantity of melting-ceramic, so that the ceramic material melts and flows into the interspacing between the projecting plug and current lead-through. The assembly is then cooled down to room temperature, and the connection between the projecting plug and current lead-through has been achieved. This is the so-called sealing-in procedure.

The distance over which the melting-ceramic flows in the interspacing

determines the length over which the gastight melting-ceramic connection extends. The length of the melting-ceramic connection is of major importance for realising a lamp of good quality. Given a length smaller than 1 mm, a comparatively weak mechanical joint has arisen with a considerable risk of a premature lamp failure.

Given a comparatively great length, the surface area of the melting-ceramic connection facing the discharge space will reach a considerably higher temperature during lamp operation than is desirable. The results of this are attacks on the melting-ceramic connection by filling ingredients of the discharge vessel and the changes in photometric properties arising therefrom (for example, colour of emitted radiation, luminous efficacy) of the lamp. This, also, will often lead to a premature end of lamp life.

Lamp manufacture on an industrial scale involves batch production. The production of the known lamp shows a wide spread in the length over which the melting-ceramic connection extends. This already leads to a high reject percentage in manufacture.

The invention has for its object to provide a measure for improving the control of the length of the melting-ceramic connection. To be a lamp according to the invention, therefore, the lamp mentioned in the opening paragraph is characterized in that at least an end portion of the projecting ceramic plug adjacent the end facing away from the discharge space is impermeable to light.

It was found that a high reproducibility of the flowing distance of the melting-ceramic can be realised during the sealing-in procedure, and thus of the length of the achieved gastight ceramic connection. According to the inventor, this is to be ascribed to an increased infrared absorption of the end portion of the projecting plug which is impermeable to light. This leads to a more homogeneous heating during the sealing-in procedure of both the projecting plug and the flowing ceramic material, which again leads to a better control of the length of the melting-ceramic connection through time control of the sealing-in procedure.

An important advantage of the invention is that a comparatively simple measure in the form of a pretreatment during component manufacture can suffice, while the existing lamp manufacturing technology, in particular the sealing-in procedure, can be maintained without modifications.

The end portion which is impermeable to light extends over a distance of at least 1 mm, preferably over a distance f at least 3 mm. This has the advantage that an

even heating takes place during the sealing-in procedure over the entire length of the melting-ceramic connection to be realised.

It is advantageous for a simple production of the projecting ceramic plug that the latter is impermeable to light over its entire length. The duration of the sealing-in procedure may be reduced owing to the strongly improved heat absorption caused thereby in the sealing-in process. This is an important advantage especially in batch production.

The projecting ceramic plug may be impermeable to light owing to an externally provided coating, for example in the form of Mo, W or C. The coating may be realised through vapour deposition, chemical vapour deposition, brushing (for example, with a W rod), or immersion in a solution (for example, molybdate) of a previously fired, but not yet sintered moulded piece which will form the projecting plug after sintering. A further possibility is to dose the moulded piece with a viscous solution (for example, molybdate), which method is also called painting.

Another possibility of obtaining a projecting plug impermeable to light is the manufacture of the projecting plug from non-translucent ceramic material. This is possible, for example, in that the ceramic material is impregnated with optical centres, for example Fe, Cr, Ni, during its manufacture.

The above and other aspects of the invention will be explained in more detail with reference to a drawing of an embodiment of a lamp according to the invention, in which

Fig. 1 diagrammatically shows a lamp according to the invention, and

Fig. 2 shows the discharge vessel of the lamp of Fig. 1 in detail.

Fig. 1 shows a high-pressure discharge lamp provided with a discharge vessel 3 with a ceramic wall enclosing a discharge space 11. In a practical embodiment, the discharge vessel contains a filling which comprises besides Hg and a rare gas at least also a metal halide. The discharge vessel is sealed at an end by means of a projecting ceramic plug 34, 35 which encloses with clearance a current lead-through (Fig. 2: 40, 41, 50, 51) to an electrode 4, 5 arranged in the discharge vessel, and which is connected to said lead-through in a gastight manner by means of a melting-ceramic connection (Fig. 2: 10) adjacent an end facing away from the discharge space. The discharge vessel is surrounded by an outer bulb 1

which is provided with a lamp cap 2 at ne end. A discharge extends between th electrodes 4, 5 in the operational condition of the lamp. Electrode 4 is connected to a first electrical contact forming part of the lamp cap 2 *via* a current conductor 8. Electrode 5 is connected to a second electrical contact forming part of the lamp cap 2 *via* a current conductor 9. The discharge vessel, shown in more detail in Fig. 2 (not true to scale), has a ceramic wall and is formed by a cylindrical portion with an internal diameter ID bounded at either end by end wall portions 32a, 32b, each end wall portion 32a, 32b defining an end plane 33a, 33b of the discharge space. The end wall portions each have an opening in which a projecting ceramic plug 34, 35 is fastened in the end wall portion 32a, 32b in a gastight manner by means of a sintered joint S. The projecting ceramic plugs 34, 35 each enclose with clearance a current lead-through 40, 41, 50, 51 to an associated electrode 4, 5 having a tip 4b, 5b. The current lead-through is connected to the projecting ceramic plug 34, 35 in a gastight manner at a side facing away from the discharge space by means of a melting-ceramic connection 10. The projecting ceramic plugs are provided with a coating 64, 65 at their ends facing away from the discharge space, so that the projecting plugs are impermeable to light. The length over which an end portion of each of the projecting plugs is impermeable to light is 3 mm. The electrode tips 4b, 5b have an interspacing EA. The current lead-throughs each comprise a halide-resistant portion 41, 51, for example in the form of a Mo-Al_2O_3 cermet, and a portion 40, 50 fastened to an associated end plug 34, 35 in a gastight manner by means of the melting-ceramic connection 10. The melting-ceramic connection 10 extends over a certain distance, for example approximately 1 mm, over the Mo cermet 41, 51. It is possible for the parts 41, 51 to be formed in a manner other than from a Mo-Al_2O_3 cermet. Other possible constructions are known from, for example, EP-0 587 238. A halide-resistant coil wound around a halide-resistant pin was among the constructions which were found to be particularly suitable. Mo is very suitable for use as a halide-resistant material. The parts 40, 50 are made of a metal which has a coefficient of expansion which corresponds closely to that of the end plugs. Nb, for example, was found to be a very suitable material. The parts 40, 50 are connected to the current conductors 8, 9 in a manner which is not shown in any detail. The lead-through construction described renders it possible to operate the lamp in any burning position as desired.

Each of the electrodes 4, 5 comprises an electrode rod 4a, 5a which is provided with a winding 4c, 5c near the tip 4b, 5b. The electrode tips in the embodiment described lie substantially in the end planes 33a, 33b formed by the end wall portions.

Th projecting ceramic plugs are provided so as to be recessed by a

distance a relative to the end wall portions 32a and 32b, and are fastened therein in a gastight manner with a sintered joint S. In an alternative embodiment of the lamp according to the invention, the projecting ceramic plugs 34, 35 are provided without recess relative to the end wall portions 32a, 32b. In that case, the electrode tips lie between the end planes defined by the end wall portions.

In a practical embodiment of a lamp according to the invention as shown in the drawing, the rated power of the lamp is 70 W. The filling of the discharge vessel is 4.4 mg Hg and 8 mg NaJ, TlJ and $(Dy+Ho+Tm)J_3$ in a mass ratio of 65:10:25. In addition, the lamp contains Ar as an ignition gas. The lamp is designed for a colour temperature of 3000 K with colour point coordinates (x,y; 437,404) and a general colour rendering index Ra above 80. The discharge vessel is made of polycrystalline aluminium oxide, has an internal diameter ID of 6.85 mm and an interspacing between the electrode tips EA of 7 mm. The projecting plugs are impermeable to light at the ends facing away from the discharge space over a length of 3 mm owing to a coating with W. The coating is realised in that the moulded piece is brushed with a W-brush, after which the moulded piece is sintered to achieve gastightness. The projecting plugs are sintered into the end wall portions at a distance a of 1 mm from the end planes defined by the end wall portions. The end wall portions have a height of 3 mm, so that the sintered joint with the end plugs extends over a length of 2 mm. Such a length of the sintered joint was found to be sufficient in practice for realising a sufficiently strong and gastight fastening between the end wall portion and the projecting plug, also in the case of large-scale batch production. The electrode tips lie in the end planes. The electrodes each comprise a W-rod provided with a W-winding at the tip.

Subsequently, a gastight melting-ceramic connection is formed between each projecting ceramic plug and an associated current supply conductor in known manner.

The melting-ceramic connection 10 extends over a length of 3 to 3.5 mm away from the end of the projecting plug facing away from the discharge space.

For comparison, data are given of lamps according to the present art. Here the length over which the melting-ceramic connection extends between the projecting plug and current lead-through varies from 3 to 7.5 mm, while in a number of cases the length cannot be unequivocally ascertained because the flowing distance of the melting-ceramic varies along the circumference of the current lead-through.

In a further practical embodiment of the lamp as drawn, the coating is realised with Mo. For this purpose, the previously moulded projecting plugs were immersed with ne end in an aqueous solution of Na_2MoO_4 and glycerin . After drying, th projecting

plugs were sintered to gastightness and simultaneously sintered to the end wall portions. A gastight melting-ceramic connection between the projecting ceramic plug and the associated current lead-through realised in the same way as for the lamp provided with a W-coating on the projecting ceramic plugs led to a comparable end result.

CLAIMS:

1. A high-pressure discharge lamp provided with a discharge vessel which encloses a discharge space, has a ceramic wall, and is sealed at one end by means of a projecting ceramic plug which encloses with clearance a current lead-through to an electrode arranged in the discharge vessel and is connected to said lead-through in a gastight manner by means of a melting-ceramic connection at an end facing away from the discharge space, characterized in that at least an end portion of the projecting ceramic plug adjacent the end facing away from the discharge space is impermeable to light.

2. A lamp as claimed in Claim 1, characterized in that the projecting ceramic plug is impervious to light over a distance of at least 1 mm measured from the end facing away from the discharge space.

3. A lamp as claimed in Claim 1 or 2, characterized in that the projecting ceramic plug is impervious to light over a distance of at least 3 mm measured from the end facing away from the discharge space.

4. A lamp as claimed in Claim 1, 2 or 3, characterized in that the projecting ceramic plug is impervious to light over its entire length.

5. A lamp as claimed in Claim 1, 2, 3 or 4, characterized in that the projecting plug is provided with an external coating.

6. A lamp as claimed in Claim 1, 2, 3 or 4, characterized in that the projecting plug is manufactured from a ceramic material which is impervious to light.

7. A lamp as claimed in Claim 6, characterized in that the projecting ceramic plug is manufactured from a ceramic material impregnated with optical centres.

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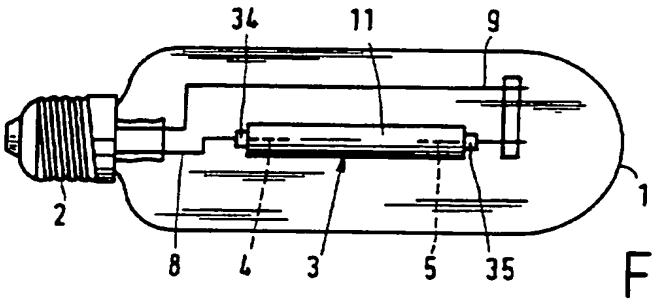
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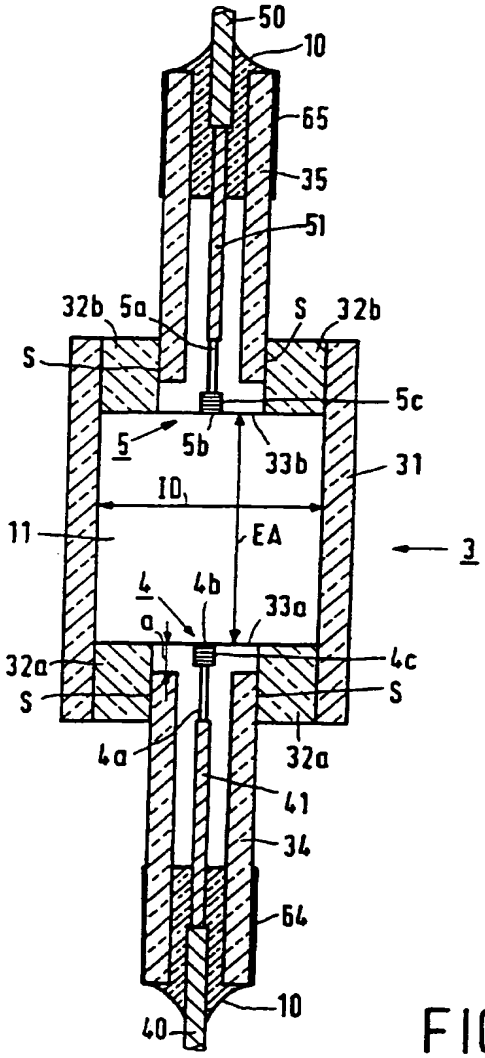
FIG.1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65
35
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32b
5a
S
32b
S
5c
5
5b
33b
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ID1
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EA
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4
4b
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33a
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4c
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4a
32a
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FIG.2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 96/00121

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01J 61/36
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0587238 A1 (PHILIPS ELECTRONICS N.V.), 16 March 1994 (16.03.94) -- --------	1-7

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
17 June 1996	24 -06- 1996
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